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February 14, 2000

SUMMARY OF THE SECOND MEETING

Special Committee 196

NIGHT VISION GOGGLE (NVG) APPLIANCES & EQUIPMENT

The Second meeting of SC-196 was held on 27-28 January at the Capri Room in the Riviera Hotel, Las Vegas, Nevada. The following participants were in attendance:

Jim Winkel, Chairman	Litton Electro-Optical Systems
Lorry Faber, Vice-Chairman	FAA
Chip Adam	FAA
Joe Altizer	Redwing Aviation
Raymond Anderson	Aviation Specialties
Dr. Chuck Antonio	Naval Air Warfare Center
Jim Arnold	FAA
Mike Atwood	Aviation Specialties
Col. William Berkley	Air Force Research Center
Michel Brulotte	Transport Canada
Jeff Craig	Air Force Research Labs
Cliff Connors	Litton Electro-Optical Systems
Joe Corrao	HAI
Keith Dodson	CAA
Maj. Rick Fullmer	Air Force Flight Standards
Dutch Fridd	Rocky Mountain Helicopters
Jim Garrett	Executive Technical Services
Keith Gladstone	National Test Pilot School
Anne Godfrey	FAA
Charlie Hamilton	FAA
Loran Haworth	NASA-Ames
Maj. Steve Hatley	Air Force Research Labs
Dan Hewitt	Aero Dynamix
Ed Hinch	FAA
Pete Hull	Rocky Mountain Helicopters
Jim Hurley	Hoffman Engineering
Roy Holmes	ITT Night Vision

Ron Jensen	Control Products Corp.
Pat Kelly	Lee County Mosquito Control
Derek Kong	FAA
Jim Lyons	CAA
John Martin	Raytheon/L-3 Comm
Cornelius McMillan	Bell Helicopters
Kevin Means	San Diego Police Dept
Ray Murphy	FAA
Greg Nolting	FAA
Dave Peltz	Tactical Air Support Consultants
Karl Poulsen	Rocky Mountain Helicopters
Randy Stewart	Department of Energy
Angelo Spelios	FAA
Terry Turpin	NASA-Ames
Don Waldrogel	Tactical Air Support
Bill Wallace	FAA
Jim Wilson	BAE Systems
Greg Winchell	Wamco

In accordance with the Federal Advisory Committee Act, Ms. Lorry Faber of the Federal Aviation Administration was the Designated Federal Representative for this meeting.

The agenda for this meeting was as follows:

1. Welcome and Introductions.
2. Chairman's Remarks
3. Acceptance of Minutes
4. Action Items Overview
5. Overview of Related Activities for NVG Lighting Compatibility
   a) Aerodynamix NVG Lighting Modification
   b) NTPS NVG Lighting Evaluation
   c) Air Force Research Laboratory's NVG Lighting Evaluation & Concerns
   d) WG 3 NVG Lighting Issue Matrix
6. Armed Forces NVG Mishap Briefing
   a) Air Force
   b) Navy & Marine Corp
7. Harmonization Status
   a) JAA
   b) NVG Export Concerns
8. Other Related Activities
   a) Rocky Mountain Helicopter NVG Usage Status
   b) Lee County Mosquito Control DC-3 NVG Usage
   c) Air Force Laboratories Panoramic NVG Study
9. Working Groups Status and Overview
   a) Working Group 1 (Operational Concept & Requirements)

b) Working Group 2 (Night Vision Goggles Minimum Performance)
c) Working Group 3 (Night Vision Imaging System Installation Minimum Performance-Lighting)
d) Working Group 4 (Maintenance & Serviceability of Equipment)
e) Working Group 5 (Training Guidelines & Other Considerations)

10. Other Business and New Action Items
11. Date and Place of Next Meeting
12. Adjourn

Agenda Item No. 1 Welcome and Introductions.

Mr. Jim Winkel opened the meeting at 0900 by welcoming all participants and asking for introductions.

Agenda Item No. 2 Chairman's Remarks

Mr. Winkel re-explained to the committee the purpose and significance of SC-196. By developing Industry Standards, this will lead to an efficient approval process for Night Vision Imaging Systems. In turn, this consensus will expedite the technical standard order for the Night Vision equipment and enable appropriate Federal Aviation Regulations to be enacted. The overview of the agenda for this meeting was presented to the committee.

Agenda Item No. 3 Acceptance of Minutes From Last Meeting

Loran Haworth had some changes to last meeting's minutes concerning his presentation of the NASA Panoramic NVG study (Item no. 6c). The new changes were accepted and the minutes will be revised for Item 6c to read as follows: "His night vision device flight evaluations generally indicate pilots err towards safety; however, a small percentage errs un-safely when estimating altitude. The committee should always consider the propensity for some pilots to err un-safely as we develop procedures and recommendations. NASA's current project is the Panoramic NVG's. This NVG provides 100 degrees Field Of View (FOV). In prior FOV studies, performance and subjective workload leveled beyond 60-80 FOV when flying helicopter related tasks. He also briefed the French NVIS helmet visor. The NVIS NVG sensors are integrated on each side of the helmet. Some concerns are with hyperstereopsis experienced during use of the NVIS where objects appear closer than in reality. Loran Haworth suggested to the committee that if future improvements would be made to NVGs that it would be in the area of field of view, resolution and adding symbology to the image display. Loran suggested that the committee consider human design requirements and not just the best state-of-the-art NVG technology in writing the MOPS document. Once the MOPS document is near completion the impact of MOPS versus human requirements should be analyzed for future civil operational considerations."

Agenda Item No. 4 Action Item Overview

Lorry Faber briefed the committee on the 12 action items that were assigned at the last meeting. She explained that 5 out of the 12 will be closed after the second meeting since they were presentations for this meeting. The other 7 items have been addressed since the first meeting, but will wait until the third or fourth meeting for distribution to the group. The action item list will be posted on the future web site, located on the FAA Rotorcraft Directorate internet site, due out Feb 25th.

Agenda Item No. 5 Overview of Related Activities for NVG Lighting Compatibility

Item No. 5a. Aero Dynamix NVG Lighting Modification - Mr. Hewitt briefed the lighting evaluation process his company utilized to obtain STC # SR09220RC. He discussed the Quantitative Testing (which included dark room evaluation) and Qualitative Testing (which included complete lighting system ground and flight evaluation) procedures followed. Ground evaluation (in a darkened hangar) included resolving a resolution chart to 20/30 NVIS system acuity, viewing through the aircraft windscreen with cockpit lighting off. After achieving 20/30 resolution, NVIS cockpit lighting system was increased to maximum intensity. NVIS continued to resolve 20/30. NVIS cockpit lighting did not degrade NVIS performance, and was deemed compatible. Dan underscored the requirement for sunlight readability of all modified instruments. Additionally, materials used in the manufacturing of windscreens and canopies vary. This affects light transmissivity. Polycarbonate windscreens (used on many helicopters), are generally more transmissive than others. Aircraft lighting, which creates glare on the windscreen, should also be considered during evaluation. External lighting effect was not included during the ground evaluation. WG-3 will consider the effect of the varied materials used in windscreens/canopies, windscreen/canopy glare and external aircraft lighting during the development of MOPS paragraphs 3.1.6 (Interference Effects) and 3.4.1.3 (Interference Effects). Normally, these sections concern with interference based on other radiated materials (interference from radio transmissions), but for our document it would be considered for this area. WG-1 will evaluate effect of aircraft lighting (e.g. exterior) on operations and include in Operational Concept. These action items will be briefed at the next meeting.

Item No. 5b. National Test Pilot School's NVG Lighting Evaluation - Mr. Gladstone presented an overview of the compatible lighting assessment process his company includes in their NVG training syllabus. This all-inclusive study of total NVIS system integration is based on 'lessons-learned' during Canadian Air Force aircraft lighting programs. Keith underscored physiological un-aided viewing limitations, which are a result of NVIS obstructing the normal un-aided field-of-view. Field of view is reduced to 40 degrees, therefore one's peripheral vision is obstructed and a pilot may need other aids within his 40 degrees to compensate (i.e. radar altimeter or emergency cueing). He also stressed the need for 'positive-habit transfer' with regard to warning, caution and advisory lights. Crewmembers are trained to respond to different colored lights. Modification to these lights will impact training and crewmember response during an emergency. Keith Gladstone's presentation will be available on the web site due out Feb 25th. WG-3 will evaluate this assessment process during development of MOPS. WG-1 will evaluate this assessment and include areas applicable in the Operational Concept. WG-5 will

identify training issues raised in this assessment and include in the Training Guidelines White Paper.

Item No. 5c. Air Force Research Laboratories NVG Lighting Evaluation and Concerns - COL Berkley presented an overview of the compatible aircraft lighting program developed at Williams AFB. He discussed the different classifications of NVIS (type 1 and type 2) and NVIS lighting filters (class "A", "B" and "leaky-green"). Quantitative evaluations indicate NVIS performance degradation is only 1% when using class "B" lighting over class "A" lighting. He discussed the misconception that merely reducing the intensity of non-compatible incandescent lighting will allow for operation of NVIS with little or no degradation to performance of NVIS. As incandescent lighting voltage is reduced, more near-IR energy is emitted causing NVIS gain to be reduced. COL Berkley also mentioned that class "A" light is naturally focused on the retinal wall, and is easier to view and resolve at night. He cautioned the committee that using a standard other than MIL-85762A must include extensive research, testing and evaluation. He stressed cockpit lighting luminance balance. COL Berkley presented Air Force video demonstrating NVIS performance degradation as a result of non-compatible aircraft lighting (both interior and exterior). He also presented a future NVIS lighting modification for the F-16, which is relatively low cost and still meets MIL-85762A. Many questions arose during the briefing concerning human visual performance with the current FAR Part 67 regulations. Colonel Berkley commented that no testing has been done with other than 20/20 correctable vision, and that there is no true accurate means to measure a human's visual acuity. He also mentioned that when determining visual acuity it is best to use the Tri-Bar chart. This chart is much faster to train individuals and allows for easy grading. COL Berkley proceeded to discuss testing tips for NVIS lighting compatibility and NVIS performance. He mentioned that if night-time readability is tested accurately on the ground, that it should be satisfactory during flight. When testing filtered displays, one should not determine light leakage by turning one's head around the cockpit with the NVG's on. Testing should take into account any reflection on the canopy with the NVG's; this does indicate light leakage and NVIS degradation will occur. An action item for NASA-Ames is to determine if a formula or easy analysis can be done to determine resultant visual acuity, and if a cutoff can be made based on the variables of human visual performance (i.e. based on FAR Part 67), NVIS appliance, NVIS lighting, and windscreen or canopy interference. In addition, the following action items will be addressed: WG-3 shall recommend the NVIS lighting standard for inclusion in MOPS during Meeting Three. Committee to reach consensus during Meeting Three on NVIS lighting standard. WG-3 shall develop luminance standards (minimum/maximum) to ensure luminance balance is maintained within the aircraft. WG-5 shall recommend a minimum acceptable resolution standard for use in evaluating NVIS lighting. The recommendation should be based on operational, environmental and human factors. WG-3 shall integrate this standard into the MOPS. WG-5 shall review existing medical standards (civil and military) relating to visual acuity. Areas for review include differing visual acuity requirements, physiological impairment (e.g. color deficiencies) and effect of medication (e.g. Viagra – which affects the retinal color photoreceptor cone cells). Colonel Berkley's presentation will be available on the web site.

Item No. 5d. Working Group Three NVIS Lighting Issue Matrix – Mr. Jim Garrett, co-chair of Working Group 3, briefed the committee of the current standards that actively exist concerning developing, implementing, and testing NVIS compatible lighting. In turn, he briefed

some issues and concerns for the committee in determining a minimum standard for the MOPS document. Mr. Garrett's matrix and issue list will be on the committee's web site for review.

Agenda Item No. 6 Armed Forces NVG Mishap Briefing

Colonel Berkley and Dr. Antonio provided "for official use only" NVIS accident summaries involving fixed and rotary wing military aircraft. Dr. Chuck Antonio and COL Berkley briefed NVG terminology, generations of NVG, OMNIBUS specification and misconceptions, once again to the group for re-clarification. Both presentations stressed that the NVIS mishaps occurred because of over-reliance of visual cues, not necessarily due to high-risk military missions. They also reminded the group that NVIS flight is very similar in nature to instrument flight. A pilot's comfort may increase due to an increase in vigilance, however one's mental processing and workload increases as well. These presentations are also available on the web site, however some detail has been deleted due to the security of the information.

Agenda Item No. 7. Harmonization Status

Item No. 7a. Joint Aviation Authorities - Mr. Jim Lyons expressed his dismay that, in his estimation, SC-196 was not giving serious consideration to harmonization between JAA and FAA. He cited our desire to set as minimum specification for the NVG the OMNI IV (or equivalent) image intensifier. Due to U.S. Department of State export restrictions, some members of JAA may not be able to import this technology from U.S. manufacturers. Mr. Lyons indicated surprise that this body is reviewing operations and training issues, as these are not typically a function of RTCA. He advised that EUROCAE (an organization similar in scope to RTCA) is forming a committee similar to SC-196. Mr. Lyons requested SC-196 to communicate and harmonize our actions with the EUROCAE committee. An action item for Working Group 1 and 5 is to invite REGA, a Swiss helicopter operator who is currently implementing NVGs, to ensure harmonization inputs for European operators are considered.

Item No. 7b. Export Concerns – Mr. Roy Holmes briefed the committee on the export status for NVGs outside the United States. Roy Holmes (ITT) provided an overview of image intensification generation technology and the U.S. Department of State's process for export. Basically, any new or current technology that the US military utilizes is subject to State department approval for export. At this time, GEN specification is not exportable. At best, GEN III OMNI IV/V technology can be exported to NATO countries or equivalent with State Department approval. Mr. Holmes presentation is also located on the committee's web site. The co-chairs of SC-196 will take the action item to establish contact with EUROCAE.

Agenda Item No.8. Other Related Activities

SC-196 heard several additional presentations representing multiple operators and advanced NVG technologies. Pat Kelly (Lee County Mosquito Control District) briefed his public-use organizations NVG program – DC-3 insecticide/herbicide aerial spray operations. Additionally, Pete Hull and Dutch Fried (Rocky Mountain Helicopters) summarized their current

Supplemental Type Certificate for their NVG operation. Finally, Jeff Craig (Air Force Research Laboratory) discussed and demonstrated the wide field-of-view Panoramic NVG. This 100-degree (horizontal) NVG is prototype technology for advanced NVG's. These presentations were useful, informative and relative to the issues the committee are addressing. Mr. Craig's presentation will be located on the committee's web site.

Agenda Item No. 9. Working Groups Status and Overview

Item No. 9a. Working Group 1 – (Operational Concept & Requirements) Karl Poulsen and Bill Wallace (WG 1 Chairpersons) reiterated that the NPRM activity is the basis for the operational concept. The underlying philosophy is that NVIS is an aid to VFR flight. A lengthy discussion ensued concerning the aircraft equipment required for NVG flight. A specific question arose as to whether the NVG standard should require all the equipment currently required for instrument flight. The final consensus answer for this question was no. The group, at this time, has reached consensus concerning aircraft equipment for intended operations, such as radar altimeter, attitude indicator and approved NVIS compatible lighting. An open issue exists amongst the group whether an instrument rating is required for NVIS operations. The working group also made some time limitation changes in terms of currency and qualification. A night vision goggle operation or event shall be required every 90 days. This requirement would appear no different than the night VFR requirement per the FARs. Group consensus accepted the two-month period in 61.57(g) for the night vision goggle proficiency check.Also, time limitation for Armed Forces personnel to gain their FAA NVG rating would be 12 months from their last NVG recorded operation. NVG flight time would only be recorded be the sole manipulator of the flight controls. In addition, the working group agreed the definition of NVIS device or NVG should be referred to as an "electrical appliance". This is also co-aligned with WG 2's definition per the MOPS. The reference of flight simulator or flight training device, which is proposed in the draft NPRM, would not be addressed in this operational concept and removal from the NPRM was requested. A recommendation was also made by the working group for the NPRM to have an Appendix for Part 91 concerning NVG approvals, very similar to CAT II operations. The group decided to defer the issues of external compatible lighting and primary vs. secondary lighting to the MOPS working group. At the next meeting, Bill Wallace will brief the committee on the status of the NPRM and any other comments implying recommendations to the ops concept.

Item No. 9b. Working Group 2 – (Night Vision Goggles Minimum Performance) Roy Holmes and Cliff Connors (WG2 Chairpersons) reiterated that the OMNI IV DoD specification is the reference for the MOPS. Currently, the MOPS has the DoD specification folded into the document. Some missing pieces concern DO-160D criteria and level of detail for test procedures. Currently, there are placeholders concerning test performance, head harness, and breakaway capability. By the next meeting, the group hopes to contain more explicit information for these sections and be able to have this draft document on the web site. An action item was given to Lorry Faber to get a sample of an approved test procedure for a MOPS, and a copy of DO-160D to reference.

Item No. 9c. Working Group 3 - (Night Vision Imaging System Installation Minimum Performance-Lighting) Jim Hurley and Jim Garrett (WG3 chairs) announced that the committee decided to remain within the working MOPS document under installation procedures (Ch. 4). In addition, the group decided to accept ASC/ENC 96-01 (located on the web site) as the basic guidance for NVIS compatible lighting for retrofit or new production aircraft. An action was given to the co-chairs of SC-196 to contact the OEMs for participation within Working Group 3. Other action items were given to Working Groups 1 and 5 concerning required goggle training for goggle failure, training for in-flight equipment failure (i.e. night un-aided VFR). An issue was posed to the committee concerning the requirement for Primary and Secondary NVIS lighting, and whether to include a night VFR white light. Even though consensus was reached stating Class B would be the minimum standard, the working group recommended that a grandfather clause be granted for Class A NVIS devices or compatible lighting that are currently approved before this document becomes firm. Also, the minimum standard shall require all modifications to be permanent and mention good practices for lighting placement based on aircraft type and model. The only interim modifications will occur during the evaluation process for a permanent modification. The group will address training in the document in reference to installation and evaluation. This will ensure standardization not only within industry, but amongst the FAA as well. An issue was posed for Working Group 4 concerning serviceability for lighting modifications. The group also reached consensus concerning external lighting; apply the FARs as written for external lighting so as not to affect the NVIS devices. This also needs to be covered in training for evaluation. This minimum guidance for evaluation will be based on the "TR-1" Armstrong Laboratories. The group will take upon the action item to look into developing a sunlight readability criteria for the document. Also, there is no design criteria for manufacturers concerning external lighting, and the group will look further into this issue by the next meeting.

Item No. 9d. Working Group 4 - (Maintenance & Serviceability of Equipment) Dave Smith (WG4 chair) was unable to attend this meeting, but via telecon with the committee chairperson relayed the following progress. Mr. Smith will be contacting US NVIS manufacturers for their current maintenance procedures. From this, he will compare the commercial with the military specifications and outline a recommended standard, to include testing procedures for routine maintenance. Minimum six month periodic testing & evaluation includes: high-light/low-light resolution test, collimation test, infinity focus test, diopter adjust and system nitrogen purge. Also, Mr. Smith is researching the FARs for serviceability criteria as well as getting information pertaining to FAA Repair Station requirements. In addition, the Randy Stewart became the co-chair of Working Group 4 along with Dave Smith. Other issues the committee brought forward for Working Group 4, concern reliability, mean time failure, and intensity of the system.

Item No. 9e. Working Group 5 - (Training Guidelines & Other Considerations) Dave Peltz and Keith Gladstone (WG5 chairs) mentioned they would provide an outline for the document. Mr. Peltz reiterated to the group, that the only formal training that has been accomplished is in the military, and the committee needs to examine how to translate that program into civilian language. In the meantime, besides aiding in WG1's document since the deadline is a couple of months away, they requested copies of training manuals to reference to establish a baseline for their group. The training work group will begin development of Advisory Circular based on NPRM.

Agenda Item No. 10. Other Business and New Action Items

Mr Winkel reiterated to the committee the purpose of this group and the documents. He reminded everyone that this standard forms the baseline for the FAA to develop a Technical Standard Order (TSO) for the NVIS appliance and will aid in developing an Advisory Circular concerning installation for NVIS compatible lighting and training requirements for operators. Many issues were brought up during the meeting, and a suggestion was made to develop an "issue tracking" list in addition to an action list. By the next meeting, a committee will nominate a designated representative for this task. Also, the action item list will be updated and briefed at the next meeting with the appropriate points of contact. This list will eventually be on the web site. In addition, each working group chairperson is asked to provide a written copy of their group's minutes and submit them to the committee's chair after completion of the meeting. These sub-group minutes will be made available for everyone's review at the next meeting.

Item No. 11 Time and Place of Next Meeting

The Third meeting of SC-196 is scheduled to take place on 28-29 March 2000 at the Rotorcraft Directorate, FAA Southwest Region Headquarters, Ft Worth, Texas 76139.

Agenda Item No. 12 Adjourn

The meeting was closed at 1400 on 28 January 2000.

Lorry Faber
Co-Chair SC-196

Jim Winkel
Co-Chair SC-196